ST60+ Rudder Angle Indicator Instrument

Owner's Handbook

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Preface

Important information

Safety notices

WARNING: Product installation & operation

This equipment must be installed and operated in accordance with the Raymarine instructions provided. Failure to do so could result in personal injury, damage to your boat and/or poor product performance.

WARNING: Electrical safety

Make sure you have switched off the power supply before you start installing this product.

WARNING: Navigational safety

Although we have designed this product to be accurate and reliable, many factors can affect its performance. Therefore, it should serve only as an aid to navigation and should never replace commonsense and navigational judgement. Always maintain a permanent watch so you can respond to situations as they develop.

EMC conformance

All Raymarine equipment and accessories are designed to the best industry standards for use in the recreational marine environment.

The design and manufacture of Raymarine equipment and accessories conform to the appropriate Electromagnetic Compatibility (EMC) standards, but correct installation is required to ensure that performance is not compromised.

Handbook information

To the best of our knowledge, the information in this handbook was correct when it went to press. However, Raymarine cannot accept liability for any inaccuracies or omissions it may contain.

In addition, our policy of continuous product improvement may change specifications without notice. Therefore, Raymarine cannot accept liability for any differences between the product and the handbook.

Product disposal

Waste Electrical and Electronic (WEEE) Directive

The WEEE Directive requires the recycling of waste electrical and electronic equipment.

Whilst the WEEE Directive does not apply to some of Raymarine's products, we support its policy and ask you to be aware of how to dispose of this product.

The crossed out wheelie bin symbol, illustrated above, and found on our products signifies that this product should not be disposed of in general waste or landfill.

Please contact your local dealer, national distributor or Raymarine Technical Services for information on product disposal.

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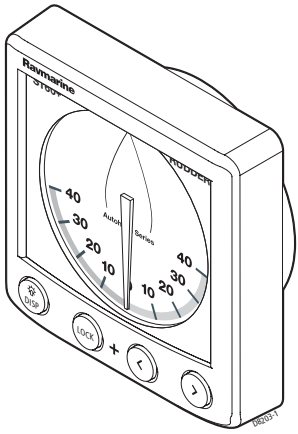
Introduction

Thank you for purchasing a Raymarine product. We are sure your ST60+ instrument will give you many years of trouble-free operation.

This handbook describes how to install and use the Raymarine ST60+ Rudder Angle Indicator instrument. This instrument gives a continuously updated (real time) display of your vessel's rudder angle.

The ST60+ Rudder Angle Indicator instrument is constructed in a rugged weather proofed case. It provides a sensitive and stable analog display, to deliver accurate information under even the most demanding conditions.



Data inputs

The instrument can be used either as a stand-alone unit, or as part of an integrated SeaTalk instrumentation system.

SeaTalk

When connected to SeaTalk, the ST60+ Rudder Angle Indicator can operate as a repeater to any Raymarine SeaTalk autopilot, or provide rudder position information to another rudder angle instrument.

SeaTalk enables a number of compatible instruments to be interconnected and operate as a single, integrated navigational system.

Power and data in a SeaTalk system are fed via a single cable, so that instruments be connected by plugging them into the network. SeaTalk is flexible enough to adapt to any number of compatible instruments without requiring a central

processor. SeaTalk can also communicate with non-SeaTalk equipment, using the internationally-accepted National Marine Electronics Association (NMEA) protocol.

In a SeaTalk system, each instrument can be either a master or dedicated repeater unit. A master instrument is directly connected to a transducer (the device that provides the raw data), and provides data and control appropriate to its function, to all other equipment on the SeaTalk network. A repeater instrument is not directly connected to a transducer but displays information provided by other equipment in the SeaTalk network.

Using with SeaTalk Autopilot

If the ST60+ Rudder Angle Indicator is part of a system which includes a SeaTalk autopilot, the rudder reference transducer is connected to the autopilot and the Rudder Angle Indicator operates in repeater mode, i.e. as a slave display to the autopilot, with the autopilot data displayed using the Rudder Angle Indicator analog pointer.

Stand alone operation

In Stand alone operation, the ST60+ Rudder Angle Indicator is connected only to a rudder reference transducer and does not display information from, or provide information to, any other instruments.

Options

Linear transducer

A Linear Rudder Reference Transducer option is available for use with 'bullhorn' type outboard installations.

Mounting

A standard ST60+ instrument is surface-mounted at the required location. If you do not want to surface mount your ST60+ instrument, options are available for:

- Flush mounting. If you have ordered the flush mounting option a low-profile bezel and four fixing screws are also provided.
- Bracket mounting.

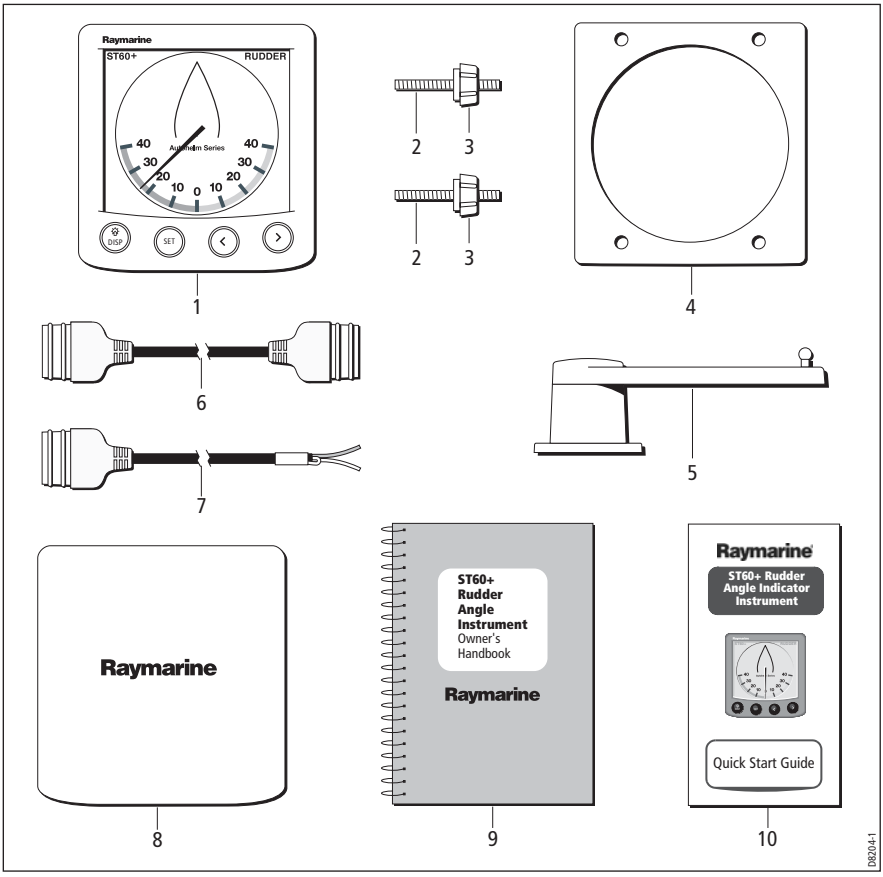
Parts supplied

Unpack your ST60+ instrument and check that the following items are present:

- Item 1, ST60+ Rudder Angle instrument with standard bezel.
- Item 2, Fixing studs (2).
- Item 3, Thumb nuts (2).
- Item 4, Gasket.
- Item 5, Rotary Rudder Reference transducer with fittings (not illustrated).
- Item 6, SeaTalk interconnection cable.
- Item 7, Power cable.
- Item 8, Instrument Cover.
- Item 9, Owner's Handbook. The Warranty document andmounting templates are included in this Handbook.
- Item 10, Quick Start Guide.

Spare spade terminals are also provided, to re-terminate the transducer cable if it has to be cut to facilitate installation.

Note: The above packing list is for an ST60+ Rudder Angle Indicator system. Where an instrument is purchased separately, a transducer is not included.


Raymarine
ST60+
RUDDER
Autohelm Series
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2
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ST60+
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Chapter 1: Operation

1.1 Getting started

This handbook describes how to operate, maintain and install the Raymarine ST60+ Rudder Angle Indicator Instrument. The instrument provides a real-time indication of rudder position as determined by the associated Rudder Reference Transducer.

WARNING: Calibration requirement

To ensure this product performs at its best on your boat, you MUST calibrate it before use, in accordance with the instructions in *Chapter 4, Calibration*. Do NOT use the product until you have successfully calibrated it.

Switching on and off

All the time that power is applied to the instrument, you can use the ☼ button to switch the instrument off and on as follows:

- To switch the instrument off, hold down the ☼ button for approximately 5 seconds. After this time, a switch off count down of 4 seconds occurs. Keep the ☼ button pressed during this period, to switch off the instrument.
- To switch the instrument back on, hold down the ☼ button for approximately 1 second.

When the power supply is switched off, none of the instrument buttons (including ☼) has any effect.

Notes: **(1)** *Each time power to the instrument is switched on, the instrument is initially in the on condition. You do not need to use the ☼ button to switch the instrument on.*

(2) *When the instrument is on, the operation of the ☼ button will perform other operating functions, as described below.*

Displayed information

The ST60+ Rudder Angle Indicator pointer shows the rudder position in real-time. The instrument scale range gives an expanded indication from -40° to +40° about zero.

Operation with other instruments

When the ST60+ Rudder Angle Indicator is connected to an operational autopilot via SeaTalk, the instrument acts as slave to the autopilot, which receives data

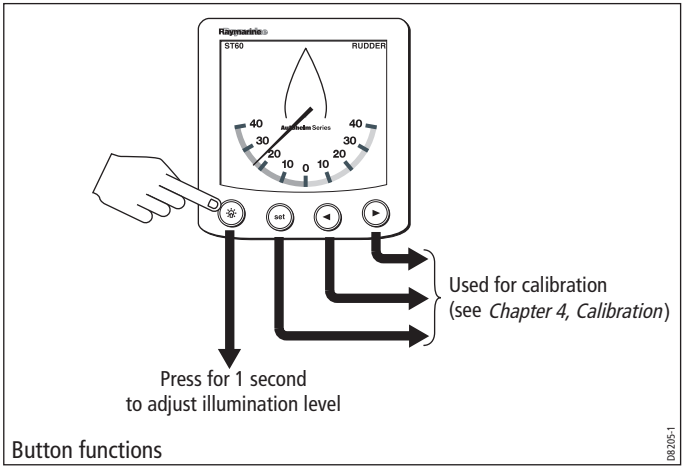
from the Rudder Angle Indicator Transducer and passes the information via the SeaTalk bus.

1.2 Normal use

As the ST60+ Rudder Angle Indicator operates in real time, very little operator action is necessary during normal use except to observe the instrument as required to ascertain the rudder angle.

Note: *If rudder angle information is not available on the SeaTalk bus, the analog pointer oscillates ±10° about the top of the dial.*

The ☼ button is the only button used during normal operation (see button *functions* illustration). The **set**, **<** and **>** buttons are reserved for calibration mode, see *Chapter 4, Calibration*. All button presses called for in this handbook are momentary, unless otherwise stated.



Button functions

Display illumination

When the instrument is first powered up, the display illumination is set to its lowest (courtesy) level, to facilitate initial access to the buttons.

To adjust the level of display illumination:

1. Hold down the ☼ button for approximately 1 second, to enter the illumination-adjust mode.
2. There are four preset illumination levels from a courtesy level to full brightness. Momentarily press the ☼ button to cycle through these levels until you

reach the level you want. The selected level is transmitted to all other instruments on the SeaTalk bus.

3. Press any other button to leave the illumination-adjust mode.

Note: *The display will return to normal operation 7 seconds after the last button press.*

1.3 Remote control

The ST60+ Rudder Angle Indicator does not support the SeaTalk remote control facility. You can control the instrument only with the front panel buttons.

Chapter 2: Maintenance & Troubleshooting

2.1 Maintenance

Servicing and safety

- Raymarine equipment should be serviced only by authorized Raymarine service technicians. They will ensure that service procedures and replacement parts used will not affect performance. There are no user serviceable parts in any Raymarine product.
- Some products generate high voltages, so never handle the cables/connectors when power is being supplied to the equipment.
- When powered up, all electrical equipment produces electromagnetic fields. These can cause adjacent pieces of electrical equipment to interact with one another, with a consequent adverse effect on operation. In order to minimize these effects and enable you to get the best possible performance from your Raymarine equipment, guidelines are given in the installation instructions, to enable you to ensure minimum interaction between different items of equipment, i.e. ensure optimum Electromagnetic Compatibility (EMC).
- Always report any EMC-related problem to your nearest Raymarine dealer. We use such information to improve our quality standards.
- In some installations, it may not be possible to prevent the equipment from being affected by external influences. In general this will not damage the equipment but it can lead to spurious resetting action, or momentarily may result in faulty operation.

Instrument

Certain atmospheric conditions may cause condensation to form on inside of the instrument window. This will not harm the instrument and can be cleared by increasing the instrument illumination to the brightest setting.

Periodically clean your ST60+ instrument with a soft damp cloth. Do NOT use chemical and/or abrasive materials to clean the instrument.

Transducer

Refer to the Installation and Maintenance instructions supplied with the transducer.

Cabling

Examine all cables for chafing or other damage to the outer shield, and where necessary, replace and re-secure.

2.2 Troubleshooting

Preliminary procedures

Changes in the electronic environment may adversely affect the operation of your ST60+ equipment. Typical examples of such changes are:

- Electrical equipment has recently been installed or moved aboard your vessel.
- You are in the vicinity of another vessel or shore station emitting radio signals.

If you appear to have a problem, first ensure that the EMC requirements (see *Chapter 3, Installation*) are still being met before further investigating the problem.

2.3 Fault location

All Raymarine products are subjected to comprehensive test and quality assurance programmes prior to packing and shipping. If a fault occurs, the following table may help to identify and rectify the problem.

Fault	Cause	Remedy
No rudder angle information.	No power supply.	Check power supply. Check SeaTalk cabling and connector security. Check fuse/circuit breaker.
No transfer of information between instruments or a group of instruments (e.g. illumination levels).	SeaTalk cabling fault.	Check security of SeaTalk connectors. Check condition of SeaTalk cables. Isolate faulty instrument by disconnecting instruments one by one.

Technical support

Raymarine provides a comprehensive customer support service, on the world wide web and by telephone help line. Please use either of these facilities if you are unable to rectify a problem.

World wide web

Please visit the Customer Support area of our web site at:

www.raymarine.com

As well as providing a comprehensive Frequently Asked Questions section and servicing information, the web site gives e-mail access to the Raymarine Technical Support Department and a details of the locations of Raymarine agents, worldwide.

Telephone help line

If you do not have access to the world wide web, please call our help line.

In the USA, call:

- +1 800 539 5539, extension 2444 or
- +1 603 881 5200 extension 2444

In the UK, Europe the Middle East or the Far East, call:

- +44 (0) 23 9271 4713 (voice)
- +44 (0) 23 9266 1228 (fax)

Help us to help you

When requesting service, please quote the following product information:

- Equipment type.
- Model number.
- Serial number.
- Software issue number.

The Software issue number can be ascertained by means of the Intermediate Calibration facility, see *Chapter 4, Calibration*.

Chapter 3: Installation

This chapter describes how to install the ST60+ Rudder Angle Indicator instrument and associated transducer.

Rotary and linear Raymarine Rudder Angle Transducers are available for use with the ST60+ Rudder Angle Indicator instrument.

If the instrument is being installed as stand-alone, the transducer cable is connected to the rear of the instrument. If being installed as part of a system incorporating a SeaTalk Autopilot, the transducer is connected to the Autopilot.

For advice, or further information regarding the installation of this equipment, please contact the Raymarine Product Support Department or your own National Distributor.

3.1 Planning your installation

Before starting the installation, spend some time considering the best positions for the instrument, such that the *Site requirements* and the *EMC installation guidelines* are satisfied.

Site requirements

Transducer

The siting of the Rudder Reference Transducer depends on the type of vessel. Fitting details and dimensions are given in the *Fitting transducers* section of this chapter.

Instrument

CAUTION: Keep the rear of the instrument dry

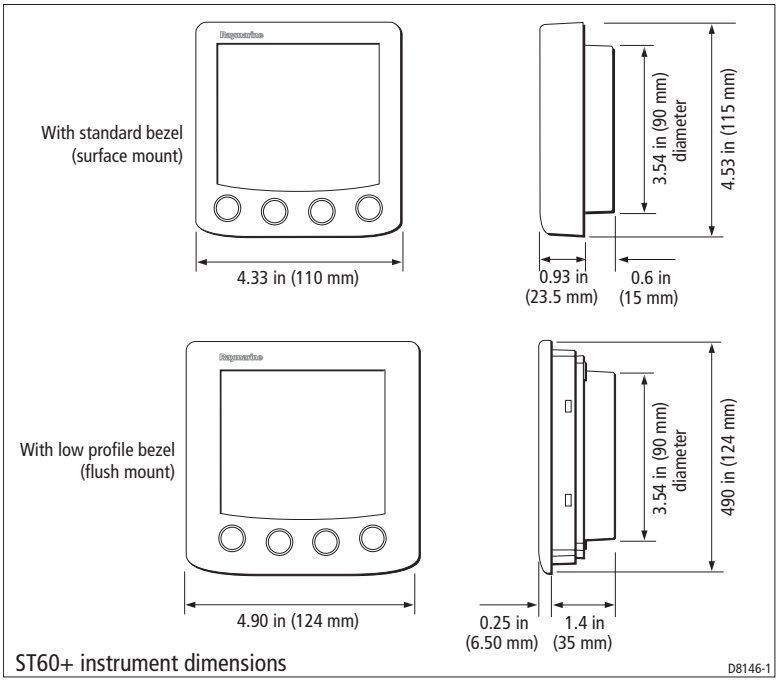
Keep the rear of instrument dry. Failure to observe this caution could result in damage if water enters the instrument through the breathing hole or comes into contact with the electrical connectors.

ST60+ instruments can be fitted either above or below deck, provided that the rear of the instrument is sited where it is protected from contact with water.

Each instrument must also be positioned where it is:

- Easily read by the helmsman.
- Protected against physical damage.
- At least 9 in (230 mm) from a compass.

- At least 20 in (500 mm) from radio receiving equipment.
- Reasonably accessible from the rear for installation and servicing.



ST60+ instrument dimensions

EMC installation guidelines

All Raymarine equipment and accessories are designed to the best industry standards for use in the recreational marine environment.

Their design and manufacture conforms to the appropriate Electromagnetic Compatibility (EMC) standards, but correct installation is required to ensure that performance is not compromised. Although every effort has been taken to ensure that they will perform under all conditions, it is important to understand what factors could affect the operation of the product.

The guidelines given here describe the conditions for optimum EMC performance, but it is recognized that it may not be possible to meet all of these conditions in all situations. To ensure the best possible conditions for EMC performance within the constraints imposed by any location, always ensure the maximum separation possible between different items of electrical equipment.

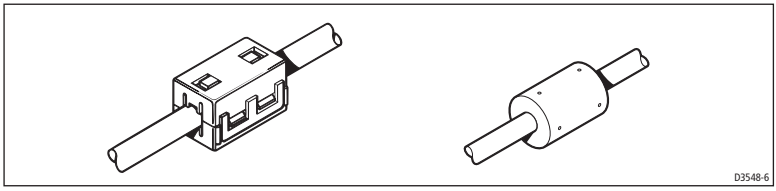
For **optimum** EMC performance, it is recommended that **wherever possible**:

- Raymarine equipment and cables connected to it are:

  - At least 3 ft (1 m) from any equipment transmitting or cables carrying radio signals e.g. VHF radios, cables and antennas. In the case of SSB radios, the distance should be increased to 7 ft (2 m).
  - More than 7 ft (2 m) from the path of a radar beam. A radar beam can normally be assumed to spread 20 degrees above and below the radiating element.
- The equipment is supplied from a separate battery from that used for engine start. Voltage drops below 10 V in the power supply to our products, and starter motor transients, can cause the equipment to reset. This will not damage the equipment, but may cause the loss of some information and may change the operating mode.
- Raymarine specified cables are used. Cutting and rejoining these cables can compromise EMC performance and must be avoided unless doing so is detailed in the installation manual.
- If a suppression ferrite is attached to a cable, this ferrite should not be removed. If the ferrite needs to be removed during installation it must be reassembled in the same position.

Suppression ferrites

The following illustration shows typical cable suppression ferrites used with Raymarine equipment. Always use the ferrites supplied by Raymarine.



Connections to other equipment

If your Raymarine equipment is to be connected to other equipment using a cable not supplied by Raymarine, a suppression ferrite MUST always be attached to the cable near the Raymarine unit.

3.2 Procedures

As it is not practical to describe procedures for all possible installation scenarios, the procedures given here describe the broad requirements for installing an ST60+ Rudder Angle Indicator instrument and its associated transducer. Adapt these procedures as appropriate, to suit your individual requirement.

CAUTION: Maintain structural safety

Where it is necessary to cut holes (e.g. for cable routing and instrument mounting), ensure that these will not cause a hazard by weakening critical parts of the vessel's structure.

Unpacking

Unpack your ST60+ instrument and check that the items detailed in the Introduction to this handbook are present.

Each ST60+ instrument is supplied with a standard bezel for surface mounting. Optional mounting kits are available for flush mounting and bracket mounting the instrument. If you have ordered the flush mounting option, a low-profile bezel and four fixing screws are also provided.

Fitting the instrument

The ST60+ Rudder Angle Indicator instrument can be installed using one of a number of different mounting options:

- Surface Mounting. Gives a profile of approximately 0.95 in (24 mm).
- Flush Mounting. Gives a profile of approximately 0.25 in (6 mm)
- Bracket Mounting.

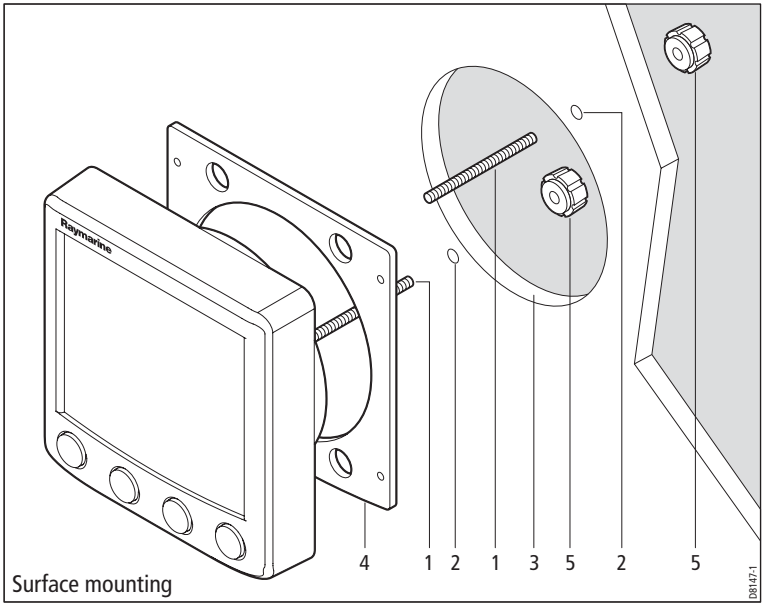
The ST60+ Rudder Angle Indicator instrument can also be mounted behind a panel with just the instrument dial and buttons visible.

Surface mounting

To surface mount your ST60+ instrument (see the *Surface mounting* illustration):

1. Ensure that:
   - The selected location is clean, smooth and flat.
   - There is sufficient space behind the location to accommodate the rear of the instrument and connectors.
2. Apply the surface mount template (supplied at the rear of this handbook) to the selected location and mark the centers for the fixing studs (1) and the aperture (3) that will take the rear casing of the instrument.
3. Drill out the two 0.2 in (5 mm) fixing stud clearance holes (2).
4. Cut out the clearance hole (3) then remove the template.
5. Peel off the protective sheet from the self-adhesive gasket (4) then stick the gasket into position on the rear of the instrument.
6. Screw the two fixing studs into the threaded sockets on the rear of the instrument.

7. Mount the assembled instrument, studs, bezel and gasket into the panel. Secure from behind with the thumb nuts (5).



Surface mounting

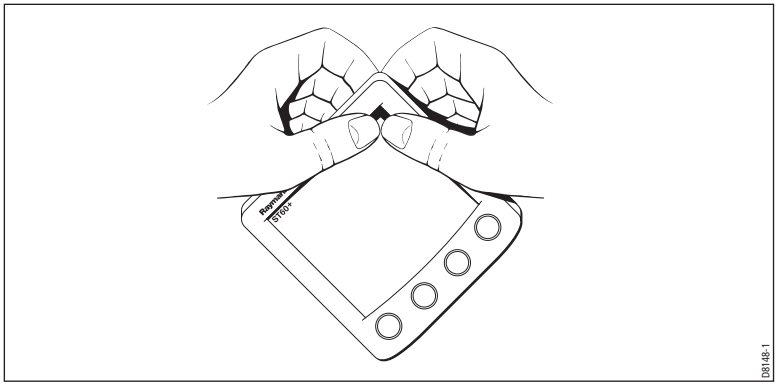
Flush mounting

The Flush Mounting Kit uses a low-profile bezel to reduce the fitted profile of the instrument to approximately 0.25 in (6 mm) above the panel fascia.

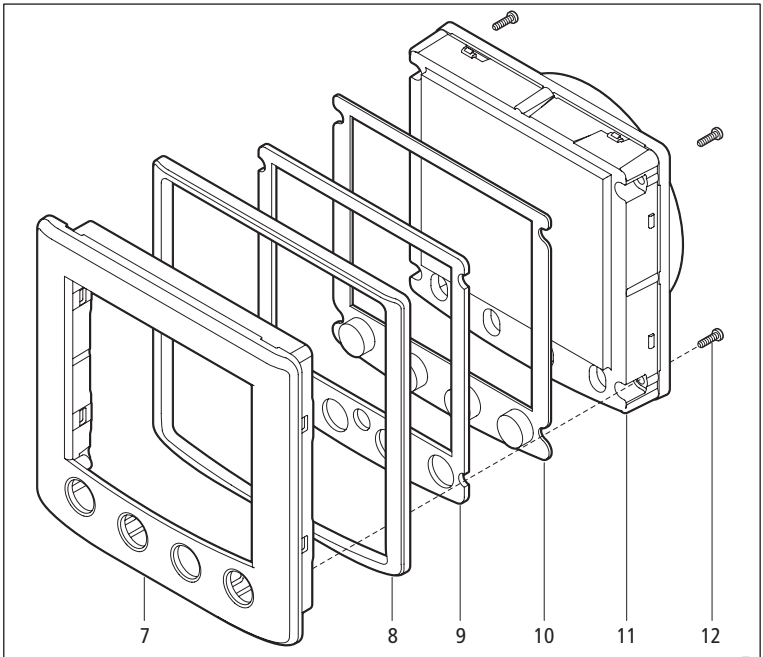
Fitting the flush mount bezel

In order to flush-mount your ST60+ instrument, you must first replace the standard bezel with the flush mount bezel as follows:

1. Hold the instrument in both hands with the display towards you.
2. Using both thumbs, gently press an upper corner of the instrument from the bezel, then remove the bezel from the instrument. Retain the rubber keypad which is released when the bezel is removed.



3. Referring to the *Fitting the flush mount bezel* illustration, insert the panel seal (8) in the corresponding recess on the back of the flush mount bezel (7).
4. Place the instrument (11) face upwards on a flat surface, then place the rubber keypad (10) in position around the display window (i.e. so that each button outline is located over its associated button on the instrument).



Fitting the flush mount bezel

5. Place the keypad seal (9) in position on the keypad (i.e. so that the holes in the seal accept the appropriate keypad buttons).
6. Place the assembled flush mount bezel and panel seal, in position on the instrument, so that the rubber keys are correctly located in the holes on the bezel, then clip the bezel and instrument together.

CAUTION: Use the correct screws

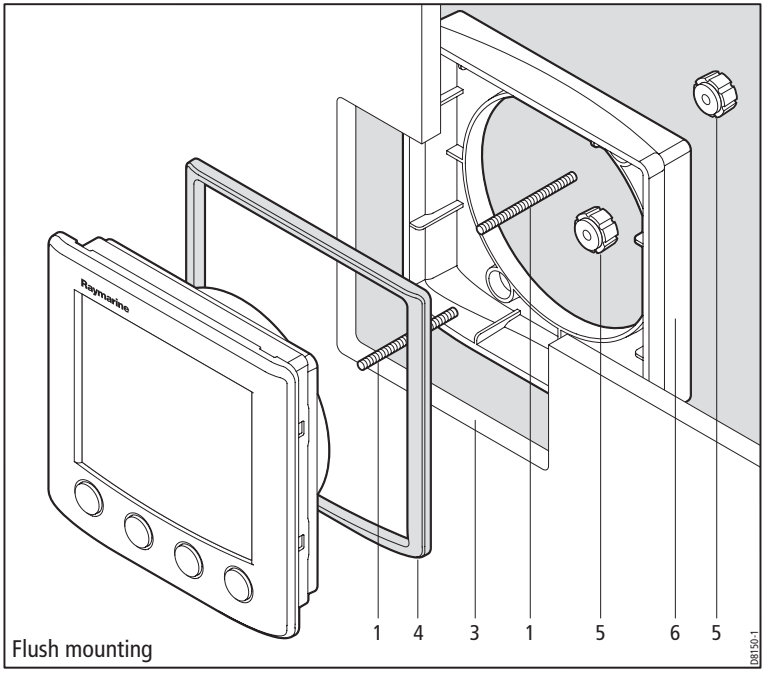
It is essential that only screws of the correct size are used to secure the instrument to the bezel. Failure to observe this caution could result in damage to both the instrument and the bezel.

7. Using the four, self-tapping screws (12) provided, secure the instrument and bezel together. Fit the screws from the rear of the instrument and tighten them sufficiently to secure the instrument and bezel together. DO NOT OVER-TIGHTEN.

Flush mounting procedure

Flush mount your instrument (see the *Flush mounting* illustration) as follows:

1. Assemble the ST60+ instrument and flush mount bezel as described under *Fitting the flush mount bezel*.



Flush mounting

2. Ensure that:
   - The panel on which you intend to mount the instrument is between 0.12 in (3 mm) and 0.78 in (20 mm) thickness.
   - The selected location is clean, smooth and flat.
   - There is sufficient space behind the location to accommodate the rear of the instrument and connectors.
3. Apply the flush mount template (supplied at the rear of this handbook) to the selected location and mark out the aperture into which the assembled instrument and bezel will sit.
4. Cut out the aperture (3) for the assembled instrument and bezel and remove the template.
5. Peel off the protective sheet from the self-adhesive gasket (4) then stick the gasket into position on the rear of the bezel.
6. Screw the two fixing studs (1) into the threaded sockets on the rear of the instrument.
7. Mount the assembled instrument, studs, bezel and gasket into the panel.
8. Locate the flush mount bracket (6) onto the fixing studs and secure the assembly to the panel with the thumb-nuts (5).

Bracket mounting

A Control Unit Mounting Bracket (Part No. E25009) enables you to mount your ST60+ instrument in locations where other forms of mounting are impractical. Although bracket mounting provides a useful alternative method for securing your instrument, it is only suitable for use in positions where the instrument will not be exposed to water.

To bracket mount your ST60+ instrument, do so in accordance with the Control Unit Mounting Bracket Instruction Sheet.

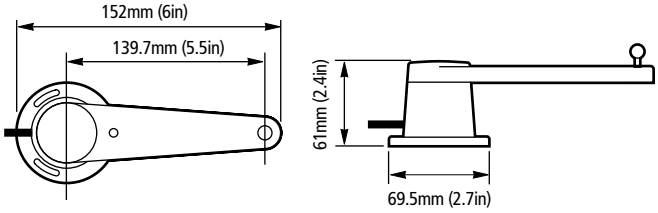
Fitting transducers

The Rudder Reference Transducer duplicates movement of the tiller arm to provide the instrument or the autopilot as appropriate, with the exact position of the vessel's rudder.

Rotary and Linear Rudder Reference Transducers are available. The Rotary type is suitable for most installations, but the Linear type is designed for use with 'bullhorn' type outboard installations. Refer to the fitting instructions for either the *Rotary Rudder Reference Transducer* or the *Linear Rudder Reference Transducer*, as appropriate.

If you are fitting an ST60+ Rudder Angle Indicator instrument as part of a system which includes a SeaTalk autopilot, the transducer must be connected directly to the autopilot. The ST60+ Rudder Angle Indicator will then act as a slave to the autopilot.

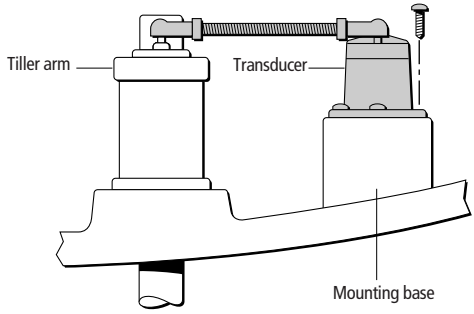
Rotary Rudder Reference Transducer



Rotary Rudder Reference Transducer - dimensions D4426-1

Mounting

1. Ensure that the base height of the Rotary Rudder Reference Transducer is such that it is able to maintain the correct vertical alignment between the transducer and tiller arm (as shown).



Vertical alignment of transducer and tiller arm D4427-1

2. Using Rotary Rudder Reference Transducer template (supplied at the rear of this handbook), mark the centers for the three securing screws at a suitable location adjacent to the rudder stock.
3. Drill out the three 3 mm holes then, using the three self-tapping screws provided, secure the Rotary Rudder Transducer in position.

Note: *To ensure precise rudder position indication, the Rotary Rudder Reference Transducer incorporates a spring to remove any mechanical backlash in the tiller linkage.*

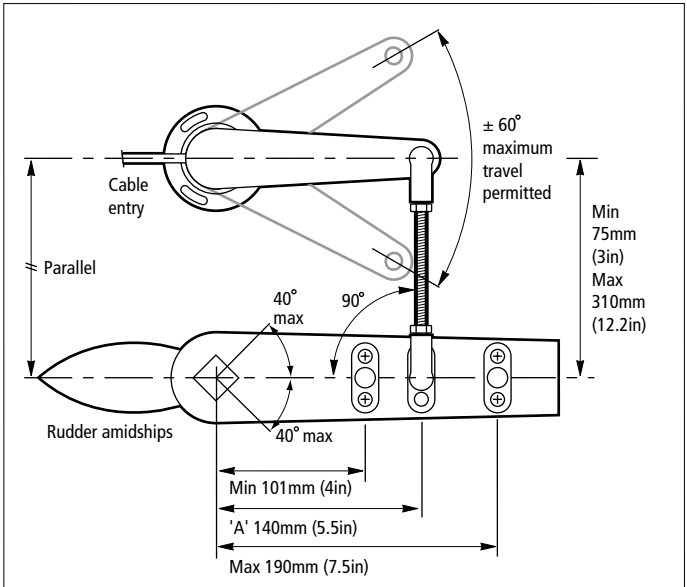
Connecting to the tiller

CAUTION: Orient the transducer arm correctly

As the Rotary Rudder Reference Transducer arm movement is limited to ±60°, ensure that you install the transducer so the arm is opposite the point of cable entry when the rudder is amidships. Failure to do this could result in damage if the arm is driven onto its end stops by the steering system.

When connecting the Rotary Rudder Reference Transducer to the tiller, ensure this is done in accordance with the limits shown in the *Rotary Rudder Reference Transducer - as fitted* illustration (below), and that the tiller and arm of the Rotary Rudder Reference Transducer are parallel to each other.

1. With the rudder amidships, ensure that the Rotary Rudder Reference Transducer arm is opposite the point of cable entry and at 90° to the connecting bar. If any minor adjustment is necessary, loosen the three securing screws, rotate the Rotary Rudder Reference Transducer body to achieve the required adjustment, then re-tighten the screws.



Rotary Rudder Reference Transducer - as fitted

D4428-1

2. Position the tiller pin within the limits shown. Ideally, dimension 'A' should be 5.5 in (140 mm). Secure the tiller ball-pin to the tiller arm using the two self-tapping screws provided.

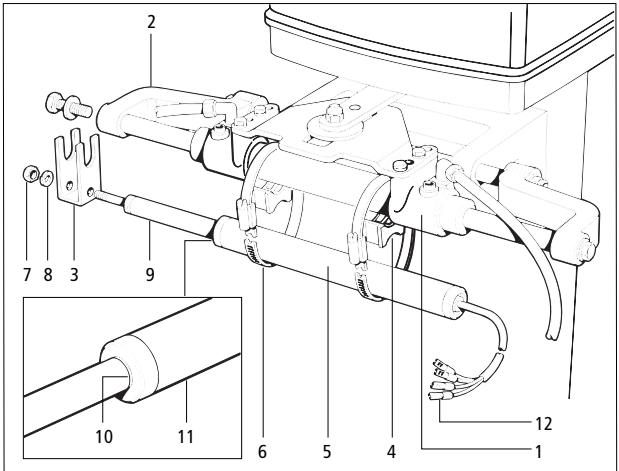
Note: *Variation within the given limits will not degrade autopilot performance but will slightly alter the scaling of the ST60+ Rudder Angle Indicator display.*

3. Cut the threaded rod to length and screw one lock-nut and ball socket onto each end of the rod.
4. Offer up the rod (with ball sockets) to the Rotary Rudder Reference Arm and tiller, making adjustments to the ball sockets as required then, supporting the ball sockets (by means of a suitable wrench) tighten the locking nuts.
5. Press each socket onto its corresponding ball-pin.
6. Move the rudder from side to side and ensure that the linkage is free from any obstruction at all rudder angles.

Note: *If the Rotary Rudder Reference Transducer has to be mounted in an inverted position, the connections for the red and green wires at the ST60+ Rudder Angle Indicator instrument (or course computer) must be reversed.*

Linear Rudder Reference Transducer

The Linear Rudder Reference Transducer is designed for use with 'bullhorn' type outboard installations.



Fitting the Linear Rudder Reference Transducer D4429-1

Mounting

1. Operate the steering system so that the 'bullhorn' ram (1) is positioned amidships.
2. Release the hydraulic pressure from the vessel's hydraulic steering system (if required). Refer to the manufacturer's instructions for correct procedures.

3. Loosen the starboard bolt that secures the 'bullhorn' ram (1) shaft to the end bracket (2).
4. Assemble the U-bracket (3) over the end bracket (2) and the shaft of the 'bullhorn' ram (1).
5. Hand tighten the starboard 'bullhorn' bolt to hold the U-bracket (3) in position.
6. Fully open the hose clamps (6) using a flat-blade screwdriver.
7. Hang the hose clamps (6) over the 'bullhorn' ram (1).
8. Site the spacers (4) on the 'bullhorn' ram (1) and hold, temporarily, with adhesive tape.
9. Pull the shaft (9) out of the linear feedback transducer (5) until the alignment mark (10) is level with the end of the body (11).
10. Position the linear feedback transducer (5) on top of the spacers (4) so that the threaded end of the shaft passes through the U-bracket (3).

Note: *The linear feedback transducer should, under normal circumstances, be assembled with the shaft (9) pointing to starboard. However, if it is not possible to orientate the unit in this way, port installation is possible provided that the red and green wires are reversed at the ST60+ Rudder Angle Indicator instrument (or course computer).*

11. With the adjustment screw and barrel aligned with the spacers, close the hose clamps (6) around the linear feedback transducer (5) and the 'bullhorn' ram (1).
12. Tighten the 'bullhorn' bolt to retain the U-bracket (3).
13. Fit and tighten the nut (7) and washer (8) to the shaft of the linear feedback transducer (5).

Transducer cabling

General

Each transducer type is supplied with sufficient cable to run from the mounted position to either the ST60+ Rudder Angle Indicator instrument (for operation as a master) or to an autopilot (for operation as a repeater).

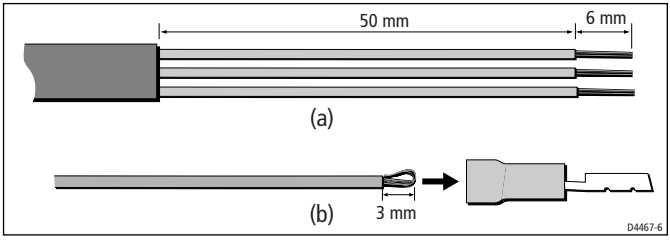
If you are connecting for repeater operation, use the instructions in your autopilot handbook to connect the transducer to the autopilot.

Running the cable

The manner in which you run the cable will depend on the locations of the transducer and instrument (or autopilot). The following guidelines are provided:

- When running cable from a Linear Rudder Reference Transducer, leave a loop of cable at the end of the Linear Rudder Reference Transducer, sufficient to allow for movement of the 'bullhorn'.

- If the cable has to be fed through the deck, always use a proprietary deck gland.
- Where cables are fed through holes, always use grommets to prevent chafing.
- Secure long cable runs so they do not present a hazard.
- Although the transducer cable is fitted with spade connectors for direct connection to the rear of the instrument, it may be necessary to remove these to facilitate installation e.g. if you want incorporate a junction box in the cable run or if the cable has to be routed through narrow apertures. Extra spade connectors are provided, to replace any that are removed when running the cable. When fitting spade connectors, prepare the cable as at (a) in the following illustration, then fold back the wire strands and insert into the spade connector as at (b). Ensure the wire strands do not extend beyond the rear of the spade connector insulation, then crimp the connector to the wire.



Connecting the instrument

Introduction

The ST60+ Rudder Angle Indicator instrument can be connected:

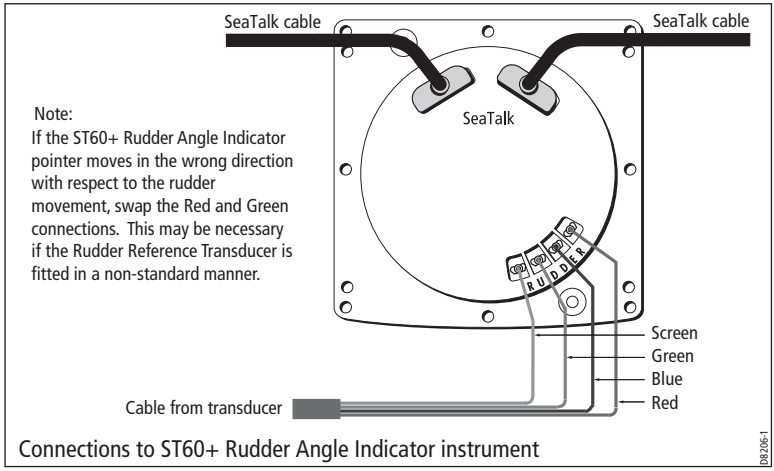
- To the transducer as a stand-alone instrument.
- To SeaTalk.

Instruments connected to SeaTalk derive their power directly from SeaTalk and no separate power connection is necessary. Where a SeaTalk system includes an autopilot, the power for the system is provided by the autopilot.

A range of Raymarine SeaTalk extension cables is available to connect separated instruments. These cables are supplied with a SeaTalk connector fitted to each end. A junction box can be used to join cables.

Signal connections

Make the necessary connections to your ST60+ instrument (see the *Connections to ST60+ Rudder Angle Indicator instrument* illustration).


SeaTalk cable
SeaTalk cable
Note:
If the ST60+ Rudder Angle Indicator pointer moves in the wrong direction with respect to the rudder movement, swap the Red and Green connections. This may be necessary if the Rudder Reference Transducer is fitted in a non-standard manner.
SeaTalk
RUDDER
Screen
Green
Blue
Red
Cable from transducer
D8206-1
Connections to ST60+ Rudder Angle Indicator instrument

Power supply connections

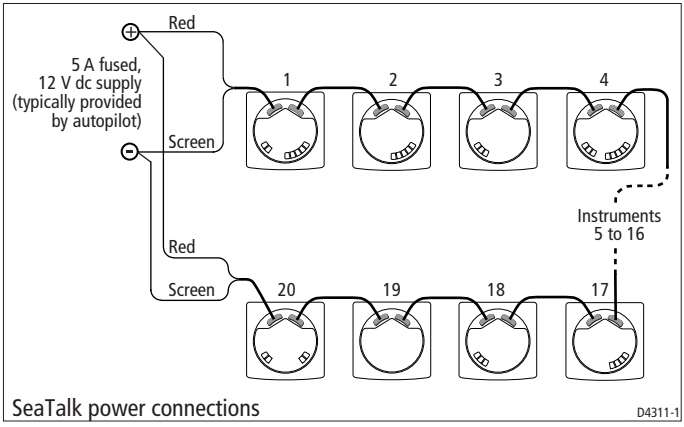
CAUTION: Protect the power supply

Ensure that the 12 V power supply for the instrument is protected by a suitably rated fuse or protective circuit breaker.

SeaTalk systems

Ensure that the power supply for the SeaTalk bus is protected by a 5 A fuse or circuit breaker.

Systems with a large number of instruments on the SeaTalk bus may require connections to the power supply from each end of the system ('ring-main' style), to maintain sufficient voltage throughout the system.



SeaTalk power connections

This requirement depends on the total length of the cable run and the total number of instruments in the system, as follows:

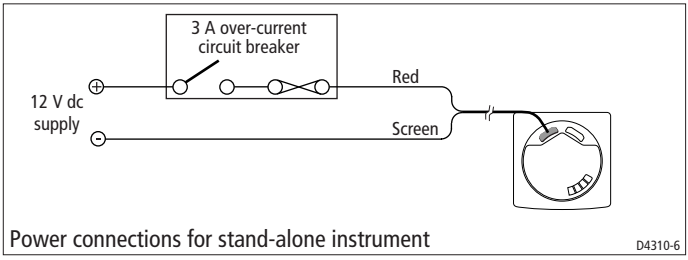
Cable run	No. of instruments	Power connections
Up to 10 m	13 maximum 26 maximum	1 2
Up to 20 m	7 maximum 13 maximum	1 2

Stand alone instruments

Stand-alone instruments are not connected to SeaTalk and therefore need to be connected to an alternative 12 V power source. Power cables are available in 2 m and 9 m lengths.

To fit a power cable:

1. Ensure the intended power source is switched off.
2. Run the power cable from the instrument to a suitable 12 V dc power source.



Power connections for stand-alone instrument

3. If the cable has not already been trimmed at the power supply end:
   i. Cut the cable to length and trim back an appropriate amount of the outer sheath.
   ii. Cut back and insulate the yellow wire.
4. Connect the screen to the power supply 0 V terminal.
5. Connect the red wire, via a 3 A fuse or protective circuit breaker, to the power supply +12 V terminal.
6. Insert the power cable connector into one of the SeaTalk connectors at the rear of the instrument.

3.3 Switching on

Switch on the power to your ST60+ instrument. When the power is on, you can use the ☼ button to switch the instrument on and off as described in *Chapter 1, Operation*.

Use the appropriate procedure in *Chapter 1, Operation* to set the backlighting to the level you want.

WARNING: Calibration requirement

To ensure this product performs at its best on your boat, you MUST calibrate it before use, in accordance with the instructions in *Chapter 4, Calibration*. Do NOT use the product until you have successfully calibrated it.

EMC conformance

Always check the installation before going to sea to make sure that it is not affected by radio transmissions, engine starting etc.

Chapter 4: Calibration

4.1 Introduction

Before using the Rudder Angle Indicator instrument for navigational purposes, it must be aligned with the Rudder Reference Transducer to counter any offset and ensure that the rudder position is accurately monitored.

4.2 Rudder angle offset adjustment

Rudder angle offset adjustment removes any deviation between the reading on the ST60+ Rudder Angle Indicator display and the Rudder Reference Transducer. To adjust for any offset, proceed as follows:

1. Center the rudder and check that the display analog pointer is within ±7° of zero. If the analog pointer reading exceeds the limits ±7°, the Rudder Reference Transducer should be realigned in order to avoid scale inaccuracies (see *Chapter 3, Installation*).
2. With the rudder centered, press and hold the **set** button for 2 seconds. The instrument will emit an audible beep to indicate that you are in calibration mode.

Note: *You can enter calibration mode only when the instrument is in master mode. If the instrument is in repeater mode and you attempt to enter calibration mode, the instrument will beep twice when the* **set** *button is released, to indicate an invalid button press.*

3. Use the **<** (decrement) and/or **>** (increment) buttons to adjust the Rudder Angle Indicator display pointer to the zero position in 1° steps, or press and hold either **<** or **>** for rapid change.
4. Press the **set** button for 2 seconds to save the new setting and exit calibration mode.

Note: *If, during calibration, no button is pressed for a period of 60 seconds, calibration mode is exited without change.*

Glossary

APP	Apparent
AVE	Average
AWA	Apparent Wind Angle (relative to the vessel)
AWS	Apparent Wind Speed
BTW	Bearing To Waypoint
CMG	Course Made Good
COG	Course Over Ground
DMG	Distance Made Good
DTW	Distance To Waypoint
EMC	Electro Magnetic Compatibility
ETA	Estimated Time of Arrival
GPS	Global Positioning System
HDG	Heading
KM	Kilometer(s)
KMH	Kilometers per hour
KTS	Knot(s)
LAT	Latitude
LCD	Liquid Crystal Display
LON	Longitude
LTR	Liter(s)

M	Magnetic or meters
MAG	Magnetic
MOB	Man Overboard
MPH	Miles per hour
NM	Nautical mile(s)
Response	The sensitivity of an instrument, to data changes.
RF	Radio Frequency
SeaTalk	Raymarine proprietary communication system which links products, to provide a single, integrated system sharing power and data.
SM	Statute mile(s)
SOG	Speed Over Ground
SPD	Speed
T	True
TTG	Time To Go
TWA	True Wind Angle relative to the vessel, taking into account the speed of the vessel.
TWD	True Wind Direction.
TWS	True Wind Speed.
VMG	Velocity Made Good.
WP	Waypoint
XTE	Cross Track Error

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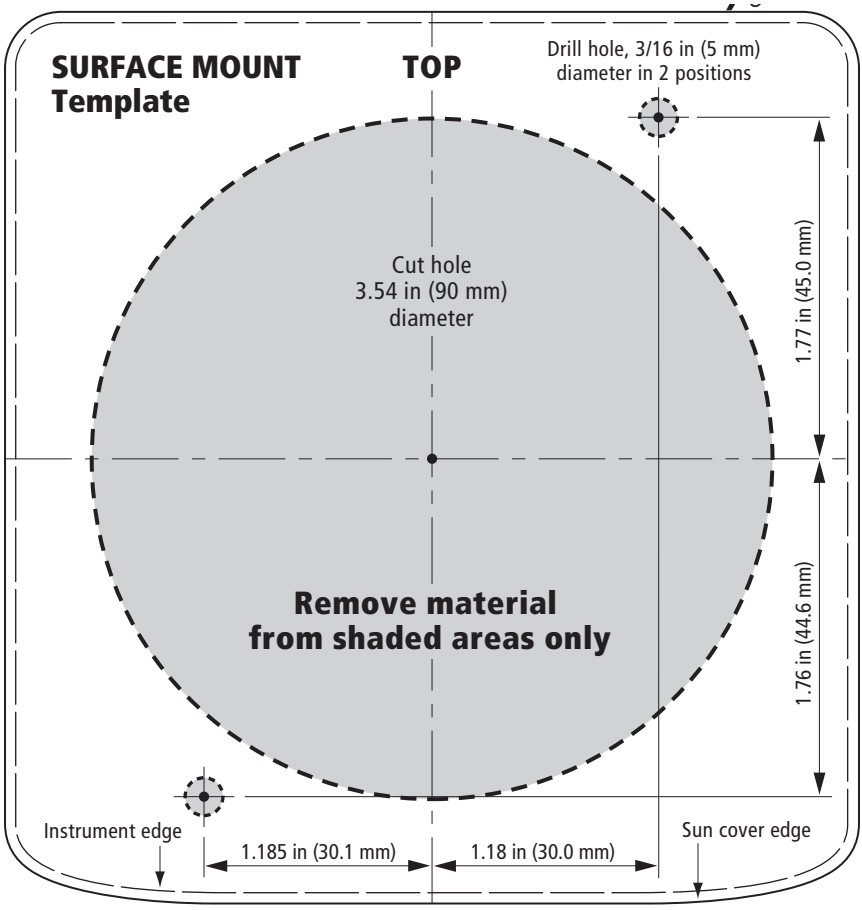
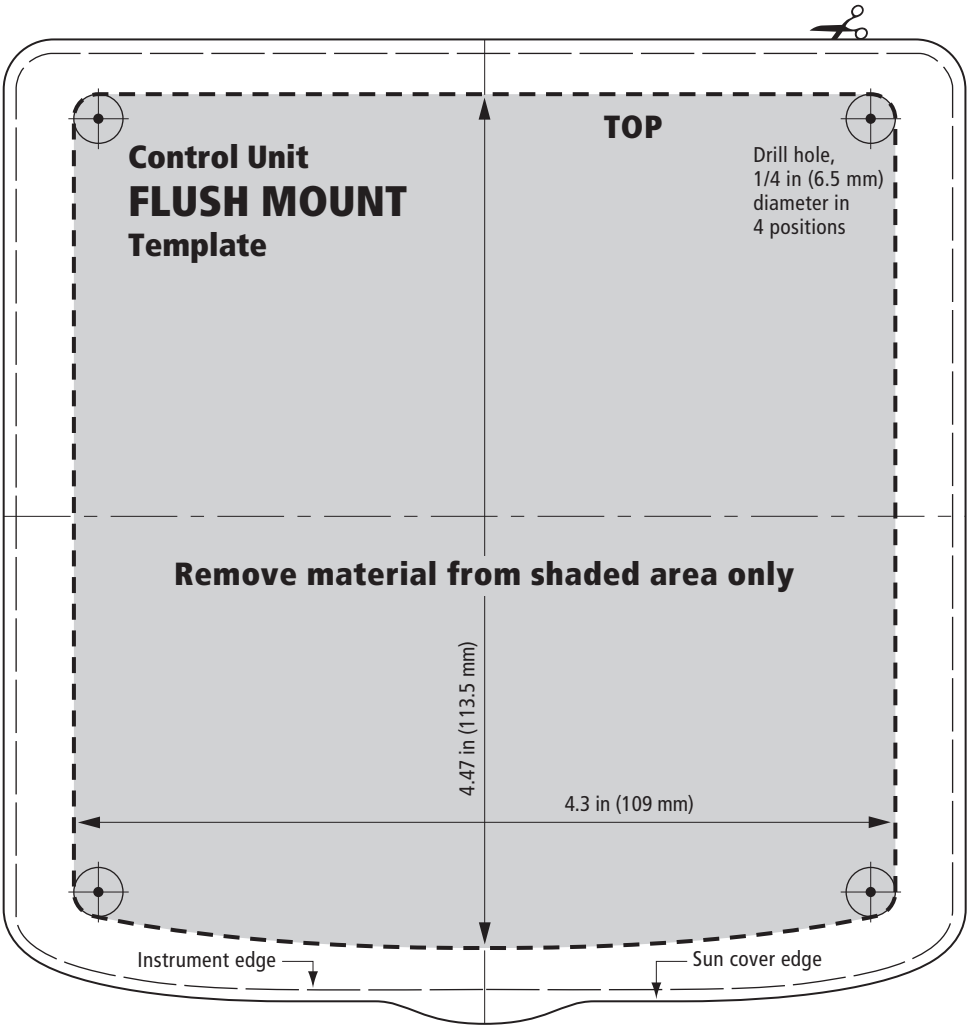


SURFACE MOUNT template for ST60+ Instruments



FLUSH MOUNT template for ST60+ Instruments